partment of Agriculture Agricultural Research Service January 1991

# Agricultural Research



**Move 'em on–**
**Bring 'em in–**
**Study 'em up and down.**

Story on page 4

## *Keep Those Cows and Cars Moving Along*

Technology transfer sometimes makes strange bedfellows. Somewhere at Fort Keogh, Montana, as a cow bellies up to the watering hole, its weight is automatically recorded by remote sensor. At the same moment, a driver zips across the Golden Gate Bridge, blissfully bypassing the toll booth—thanks to a different use for the same ARS-developed cattle-tracking system.

It all started with a cow-weighing problem at the USDA Fort Keogh Livestock and Range Laboratory, the setting for this month's cover story by Dennis Senft.

"Collecting adequate livestock weight data in a timely manner has always been a problem for animal researchers," says Bradford Knapp, ARS statistician. "When I started working here at the laboratory in 1979, we had to conduct roundups every time we needed to weigh our cattle, sometimes every few weeks, depending on the study."

What was called for was a way for the cows to weigh themselves—and ARS scientists helped develop one.

The solution—electronic scales located at a water trough and transponders worn on the ears of the free-ranging steers and cows. Each time an animal drinks, its eartag signals the scale apparatus beneath its hooves.

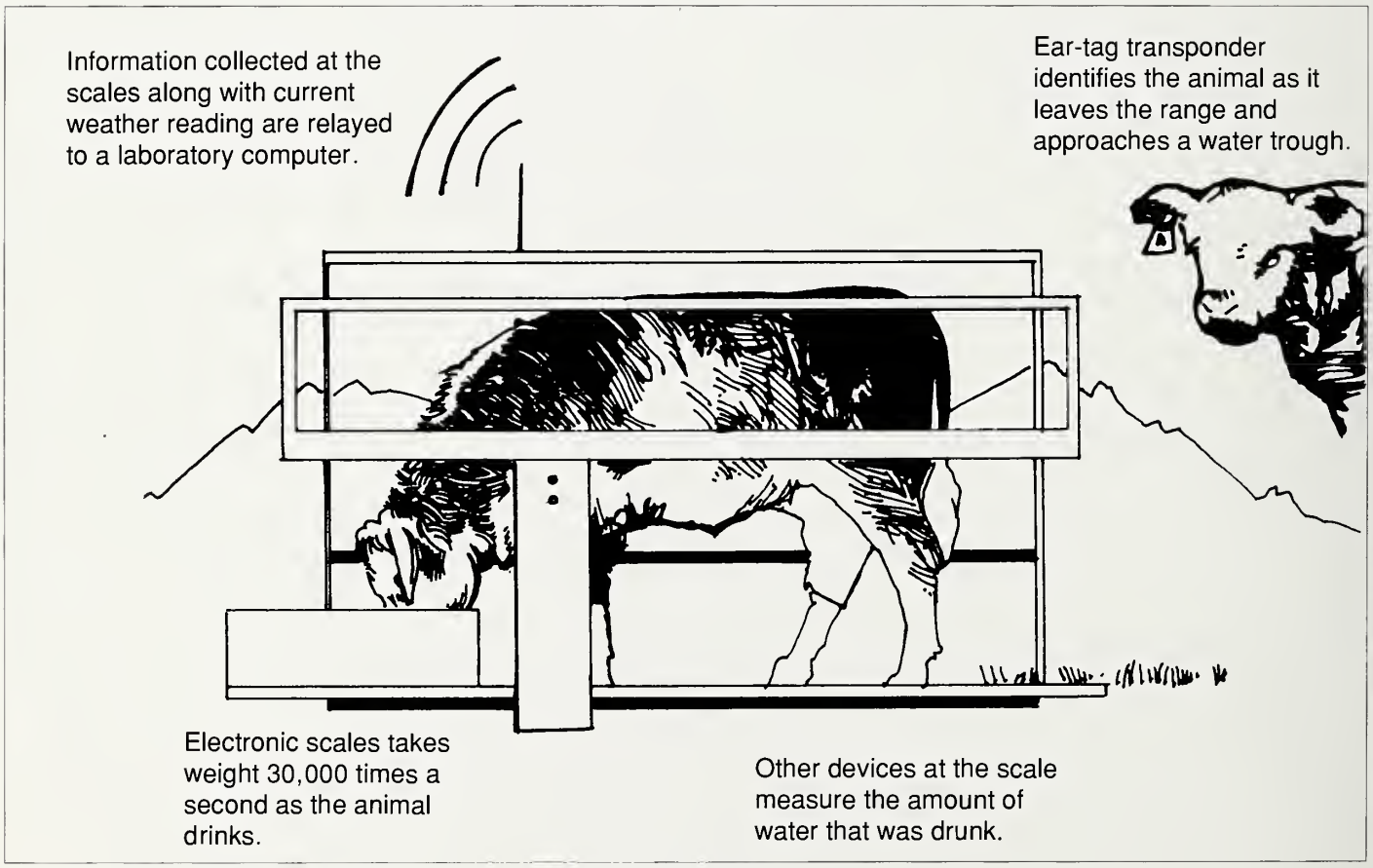
Knowing specifically which herd member is being weighed, the scale can instantaneously transmit the data from the field to a laboratory computer.

The system has applications beyond agriculture, the San Francisco Chronicle reports. Amtech Systems Corp., a Dallas firm, has adapted the same pulse-emitting tag that cattle wear for the windshields of commuters' cars.

When a vehicle approaches the toll gate and comes into antenna range, the antenna sends a signal to the car-mounted tag. The tag responds by firing back the automobile's account number. A computer-generated bill will follow, so the driver need not slam on the brakes and pass money.

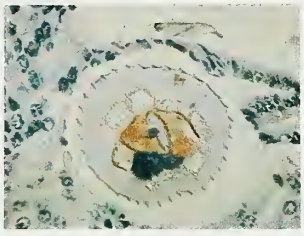
Already in operation in Louisiana, Texas, Oklahoma, and New York, the system may be in place on all eight San Francisco Bay bridges by late 1992.

**Regina Wiggen**
**Associate Editor**



# Agricultural Research

**Cover: ROUNDUP...at the Fort Keogh Livestock and Range Research Station in southeastern Montana. At this station, one of the largest in the world of its kind, researchers help to ensure a plentiful supply of meat while protecting the rangeland environment.** Photo by Jack Dykinga. (K-3908-1)



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JACK DYKINGA

# Beef Research in Big Sky Country

At Fort Keogh, you can't take the cowpoke out of the scientist. Particularly when new frontiers beckon.

Cody Taylor rides through tall grass during a roundup at Fort Keogh. (K-3908-11)

Indian tribes lived for thousands of years on this land. Unimpeded by fences, buffalo grazed millions of acres in seasonal migrations, moving on to greener pastures when necessary and returning when the high grasses grew back.

But gold seekers, arriving in the early 1860's, then settlers, pushing ever farther west after the end of the Civil War, spelled tragedy for the Indian's way of life.

Settlement brought the cavalry. It's because of Custer that today 56,000 acres in southeastern Montana are reserved. And, indirectly, Custer's loss ensured a brighter future for cattle ranchers.

Agricultural scientists now work this reservation, one of the largest research ranches in the world.

Where the cavalry once patrolled, researchers help ensure a plentiful supply of high-quality meat while continuing to protect the rangeland environment.

"Overgrazing is not a new phenomenon on most rangelands of the world," says Rod Heitschmidt, range ecologist and Research Leader at Fort Keogh Livestock and Range Research Laboratory, Miles City, Montana. "It's well-known that buffalo often overgrazed these rangelands just as many of the early settlers' livestock did."

"Once buffalo herds overgrazed, nature gave the rangeland a rest; the buffalo either moved on to better forage or died of starvation. In contrast, many early livestock producers were able to keep their animals on the lands longer by feeding hay or grain. The result was repeated overgrazing," says Heitschmidt.

"Today, however, overgrazing is the exception rather than the rule. Livestock managers have learned to balance the fragile relationship between forage production and forage demand by adjusting herd size," says Heitschmidt.

"Early studies on rangeland management at the laboratory produced a basis for ranchers to safely match cattle population to available forage. Use of this information reduced some of the risk of ranching and took the Plains out of an era of exploitation," says Pat O. Currie, local rancher and range scientist now retired from ARS.

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Historic officer's quarters under renovation by the Miles Foundation Historical Society. (K-3912-11)

Some ranching practices have cut soil erosion by up to 90 percent and increased forage yield twofold, increasing both domestic livestock production and wildlife populations. Agricultural output in Montana alone has increased by an estimated $1 billion since 1950 because of the guidelines for grazing. North Dakota, South Dakota, Wyoming, Nebraska, and parts of Canada have profited, too.

Besides better management of the native forages, scientists have sought grasses that provide more nutrition than some of the less palatable native species. Over the years they have tested more than 100 different species under various range conditions.

As a direct result of work done at Fort Keogh, nearly 2.5 million acres

of the Northern Great Plains have been seeded to crested wheatgrass and Russian wildrye. Scientists have shown improved rangelands increase calf production about 17 percent over native range, says Currie.

They also test new hybrid grasses developed by ARS scientists at other locations. One of the most promising, developed at Logan, Utah, is a cross between quackgrass and blue bunch wheatgrass, known as the RS2 hybrid. RS2 combines the tenaciousness of a weed with the nutritiousness of a forage grass—producing up to five times as much forage as some native grasses, says Currie.

### Pedigree With a Purpose

"The first large-scale linebreeding program in beef cattle in the United States was started at the laboratory in 1934 and continues to this day. No new bulls or cows have been added to the original 50-head gene pool, called Line 1. Scientists proved that linebreeding—making close matings to an outstanding individual to increase the frequency of its superior genes—coupled with a strict selection for performance, is an effective method to improve beef cattle," says geneticist Mike MacNeil.

Most Hereford cattle in the United States that are registered with the American Hereford Association have some Line 1 breeding in their pedigree. Offspring from these Line 1 Herefords have occasionally sold for more than $100,000 at the station's periodic sales.

In 1977, Line 1 was divided into two herds. One group continues as a control group selected for increased growth while the second herd is being bred to produce calves with

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**The old cavalry barracks are framed in the doorway of a modern feed mill on the Fort Keogh Livestock and Range Research Station. (K-3911-1)**

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lower birth weights coupled with high growth rates.

"One of the industry's most serious problems is that we've been too successful—we've bred cattle that produce calves too large to pass between the mothers' pelvic bones.

"But so far, we have managed to reverse that trend and produce bull calves that weigh 5 percent less at birth. Now our challenge is to get these calves to gain weight fast to make up for the reduced birth weight," says MacNeil.

"Our current research focuses on developing breeding objectives that identify biological characters that affect profitability on a sustained basis. Developing more efficient livestock to convert grasses into tender lean meat is time-consuming," says animal geneticist Scott Newman. He has identified traits like forage intake of grazing animals and reproductive rate as matters that require greater emphasis in selection programs.

### Keep Up the Calving

Cows that fail to become pregnant are cattle producers' biggest headache, says animal physiologist Robert Bellows. Additional studies should provide clues and also determine why about 20 percent of the nation's beef cows do not breed during a normal season.

A second problem is caused by calves that die at or shortly after birth. An estimated annual nationwide loss of 3.5 million calves, worth

**Top: Animal physiologist Robert Bellows prepares to implant a 7-day-old embryo into a surrogate mother (background). (K-2968-4)**

**Bottom: Mike Woods shoes a horse in Fort Keogh's old cavalry remount barn. Maintaining working horses in peak condition is vital to the daily operations of the research station. (K-3906-7)**

JACK DYKINGA

about $850 million, is attributed to calving problems.

So far, researchers have proven that proper nutrition and genetic improvement of heifers can increase conception rates by 20 percent. Simply feeding heifers in separate groups based on heavy or light weaning weights resulted in a 19-percent increase in pregnancy rate during the first breeding season with no increase in feeding costs.

Poor nutrition, caused by inadequate forage or supplements, is the major reason cows do not rebreed or rebreed late in breeding season, causing a 15 to 25 percent reduction in potential pounds of calf weaned per cow.

Sixty percent of calf losses could be prevented by giving timely and proper assistance to cows experiencing calving difficulties. Assistance also reduces rebreeding difficulties and promotes healthier mothers.

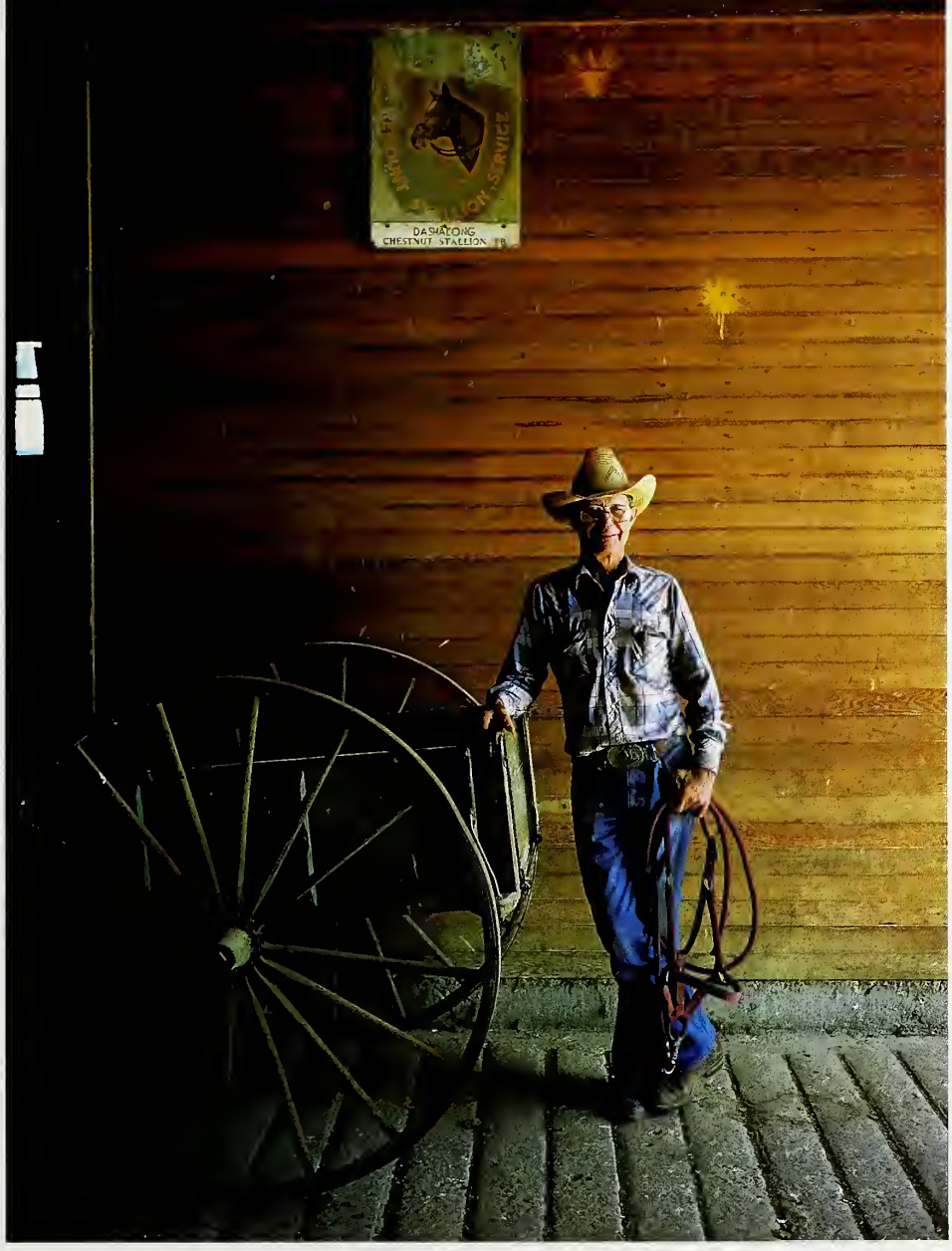
The station was among the first to successfully combine synchronization of estrus and drug treatments for superovulation—where many eggs are shed. Superovulation is a critical part of any successful embryo transfer program, but results are often unpredictable—sometimes no eggs are shed by the ovaries, other times 30 to 40.

"Spontaneous or disease-caused abortions continue to be a significant problem for cattle producers," says Robert Short, animal physiologist. "Most causes are unknown, but we are certain Ponderosa pine needles cause abortions. So far, we've found no way to prevent such abortions.

JACK DYKINGA

**Top: Pronghorn antelope and other wildlife are abundant on the Fort Keogh rangeland. (K-3912-1)**

**Bottom: Laboratory technician Ann Darling pipeting serum for radioimmunoassay of pine needle poisoning, which causes abortions in cattle. (K-2968-16)**




JACK DYKINGA

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We do know, however, that blood flow to the cow's uterus is interrupted after she eats pine needles and we are trying to find out why."

Another major area of inquiry at Fort Keogh is the management of replacement heifers—young females that go back into the breeding herd to produce the next generation of calves.

"We've learned that heifers that get pregnant early in their first breeding season will tend to do so the rest of their lives, and hence are more productive as brood cows," says Robert Staigmiller, animal physiologist.

At Fort Keogh, scientists have also:

- Demonstrated that the effectiveness of complementary forages can supplement cattle diets and defer grazing of native ranges until later in the year, thus protecting the rangeland environment.
- Demonstrated the importance of having beef cows prepared for winter. They must have adequate fat reserves at calving to ensure maximum pregnancy rate the following spring.
- Developed a Range Improvement Machine that forms water holding areas while seeding grasses and legumes. Its use has been shown to increase range production two- to three-fold in areas where conventional seeding techniques were unsuccessful.—By **Dennis Senft**, ARS.

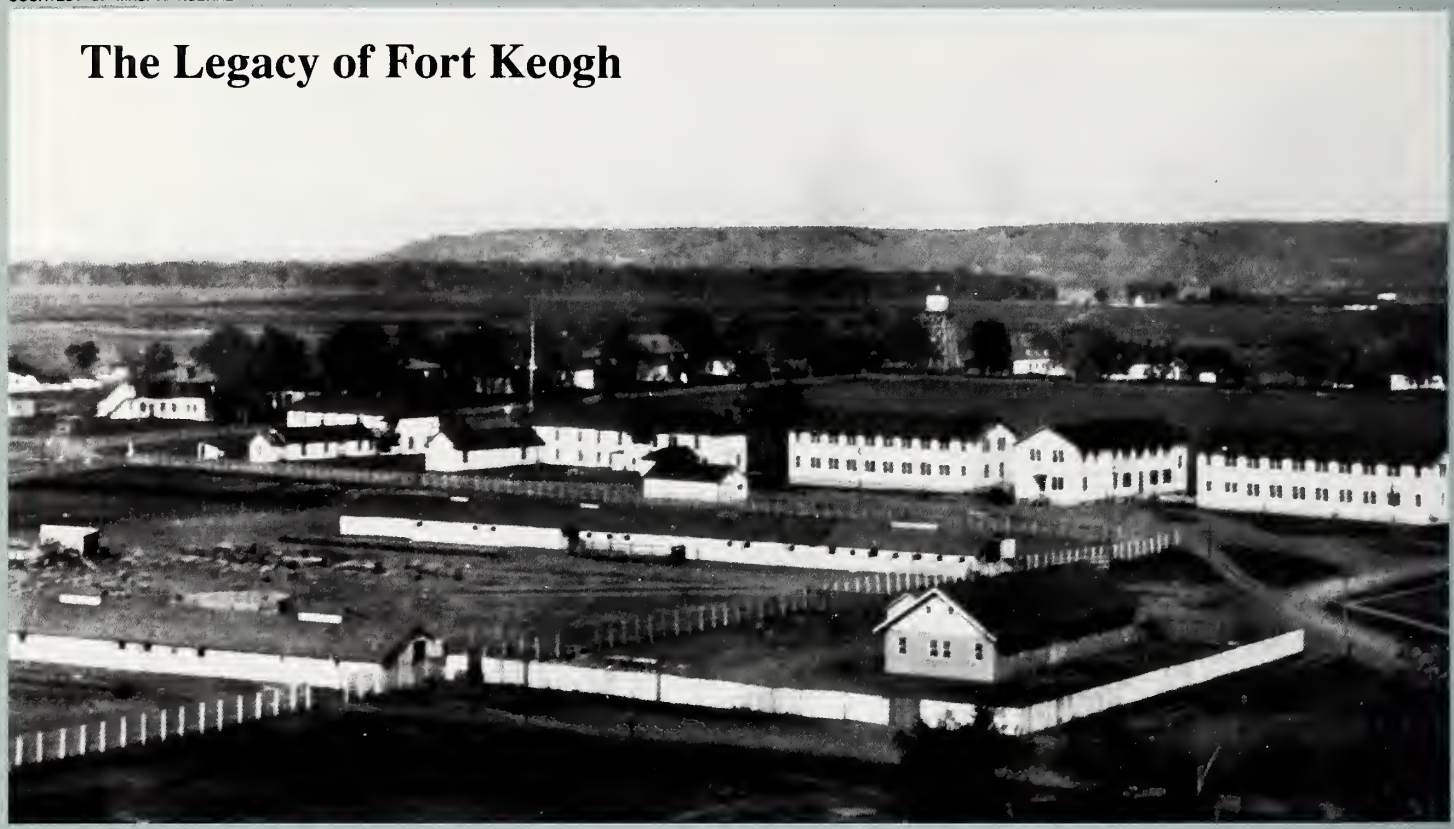
*Rod Heitschmidt and his staff are located at the USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Rte. 1, Box 2021, Miles City, MT 59301 (406) 232-4970.* ◆

**Top: Veteran cowboy Andy Shafer at the old cavalry remount horse barn. (K-3905-1)**

**Bottom: Plant physiologist Marshall Haferkamp inspects improved forages for row spacing at a range test plot at Fort Keogh. (K-2973-11)**

COURTESY OF MRS. A. KOERNER

# The Legacy of Fort Keogh



**Fort Keogh, circa 1930. Paddleboats on the Yellowstone River, which flows at the base of the buttes behind the fort, carried materials used to construct the buildings from St. Louis, Missouri. Other wood came from nearby forests along the river and was milled at a government-constructed sawmill.**

Shortly after the deaths of Colonel George Armstrong Custer and Colonel Myles Keogh, one of his officers at the Battle of the Little Big Horn on June 25, 1876, General Nelson A. Miles was sent to the area with orders to establish a fort.

Miles selected a strategic site where the Yellowstone and Tongue Rivers meet from which to conduct a military campaign against the Indians. On July 22, 1876, Congress established the Fort Keogh Military Reservation.

Miles succeeded in his mission—by the early 1880's most of the tribes had surrendered and were moved onto reservations. In 1907, all infantry troops were removed, and 2 years later the fort became a remount station of the U.S. Army. Fort Keogh supplied thousands of horses for World War I.

In 1924, the station was turned over to USDA. Since then it has been making history as a living laboratory for scientists developing management plans that improve beef production and ultimately meat quality.

"There were probably 120 buildings at the fort in the late 1800's. Today only four survive. Three are officers' quarters, one of which houses part of our museum collection, and the fourth is an old brick structure that formerly held the water wagons," says Bob Barthelmess, curator of the Range Riders' Museum, Miles City.

"My grandfather arrived here in 1886. While the military activities were pretty much over by that time, he did chase Chief Sitting Bull," says Barthelmess.

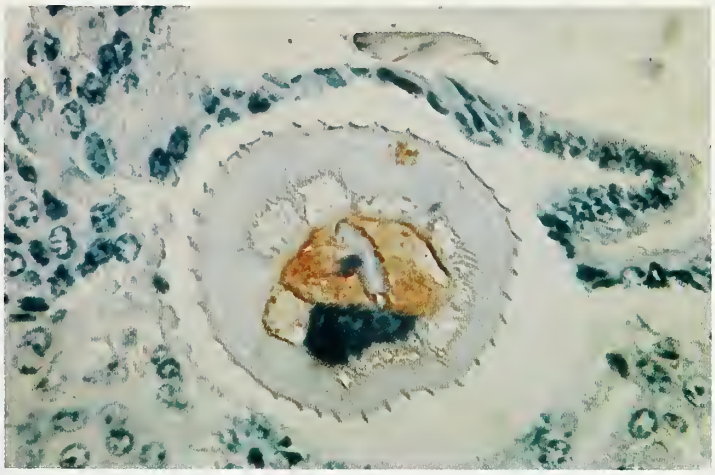
"The fort's greatest population at any one time was probably in 1895 when 800 troops and officers, plus another 500 civilians, were present. At that time, the surrounding area was essentially virgin grassland."

Today, 45 permanent employees are involved in research activities. Twelve are with ARS, and 33 are with the Montana Agricultural Experiment Station.

Animal herd size at the laboratory is about 2,000. During the year, ten to 20 cowboys are hired to move livestock around on the property.—By **Dennis Senft**, ARS.

# Protecting Parasites Prevents Gastro-damage

PHILLIP H. KLESIUS



**A cross section of a stomach parasite *Ostertagia ostertagi* magnified about 250 times. Rust-colored area is source of a chemical attractant that causes the host's infection-fighting white blood cells to attack.**

Some folks might find Phillip Klesius' philosophy on internal parasite infection in livestock a little shocking. In a nutshell, it's "live and let live."

In fact, Klesius, who is an Agricultural Research Service microbiologist, goes a step farther. At the Animal Parasite Research Laboratory at Auburn, Alabama, he's developing a vaccine that would actually run interference between the parasite and the animal's own immune system.

That's because, in the natural chemical warfare between immune system and parasite, the immune system plays so rough that it causes more damage to the animal than the parasites do, Klesius contends.

Gastrointestinal parasites such as *Ostertagia ostertagi* typically get into a grazing animal's body by being gobbled up along with forage. The invaders then tuck themselves away in fingerlike gastric glands in the abomasum, the true stomach of ruminants such as cattle.

"The parasites cause a minimum of damage inside the animal as they mature or develop," Klesius notes. "And there's no evidence they produce any toxins that would result in the physical damage we normally associate with parasite infection."

However, the parasites do produce chemical materials called excretory-secretory substances. Within these substances is a chemical attractant. This attractant, discovered by Klesius in 1986, causes infection-fighting white blood cells called eosinophils to migrate to the site of parasite infection.

The arrival of the eosinophils is hardly good news for the infected animal. Eosinophils carry tiny bags of toxic enzymes to unleash on the parasites. But those same enzymes also wreak havoc on cells in the gastric glands where the parasites are snuggled, destroying the glands.

"The gastric glands are vital to digestion because they produce pepsinogen, which converts to the enzyme pepsin," explains Klesius.

The internal struggle between enzymes and parasites, with its accompanying devastation, leaves farmers with an animal that doesn't gain much weight, no matter how much it eats.

However, there is a bright spot in this generally grim situation, according to Klesius. The peculiar bond between the parasites and the animal's own immune system could offer researchers a new route for circumventing the damage usually associated with parasite infection in livestock.

"We want to neutralize the chemical attractant produced by the parasite, and any other substances from the parasite that cause a reaction in the host animal's immune system," Klesius says.

"If, for example, the cow's body doesn't recognize that *Ostertagia* is present, it won't wind up with gastric glands damaged by eosinophils. The parasitic relationship would result in no disease."

Once they've identified the materials, they plan to use them as the basis for a vaccine to stimulate the animal's immune system to produce antibodies against the parasite's secretions.

"These antibodies will naturally neutralize substances such as the chemical attractant as soon as the parasites produce it," Klesius says. "This way the eosinophils never get the signal to migrate.

"We'll set up trials where we vaccinate the animals with material to neutralize the attractant from the parasites," he adds. "Then we'll infect them with gastrointestinal parasites and see if they show any of the typical signs of infection, such as poor feed conversion."

If this chemical interference works, Klesius and his co-workers may be opening the door to a new world of preventive medicine for livestock.

In the past, concepts for developing antigens in vaccines to control animal parasites have depended on finding substances from the parasites that stimulate the host's immune system to produce antibodies that eliminate the parasites.

"That approach works in developing vaccines against viruses and bacteria, but it's been largely unsuccessful with parasites—probably primarily because of the extremely complex relationship between the parasite and the host," he notes.

"We think our approach will work with any internal parasite that produces excretory-secretory substances; the concept of neutralizing a possible chemical attractant would apply."—By **Sandy Miller Hays,** ARS.

*Phillip H. Klesius is at the USDA-ARS Animal Parasite Research Laboratory, P.O. Box 952, Auburn, AL 36831 (205) 887-3741.* ◆

# One Stunt Tomato Growers Don't Want To See

## A problem in the Valley since 1977, the bushy stunt virus lives in the soil and flourishes in the cool weather of late winter.

A silent killer lurks in tomato fields of southern California's Imperial Valley. Last year's victim: 20,000 tons of tomatoes—fresh-market harvests that never made it to the produce section of your supermarket and cannery-type processing tomatoes that never saw the inside of a catsup bottle or salsa jar.

Scientific sleuthing by ARS plant pathologists James E. Duffus, James S. Gerik, and co-researchers revealed several years ago that the mysterious affliction was caused by tomato bushy stunt virus.

And although the virus and disease are known to occur in tomato fields in North Africa and Europe, they were never before found here, says Adolph F. Van Maren, former Imperial County farm adviser who helped identify the culprit virus.

So now, Duffus and Gerik in their labs at Salinas, California, are seeking a fast, simple test that tomato breeders can rely on to judge tomato varieties' natural ability to shrug off the debilitating virus.

"Resistance is the cheapest and most practical weapon against bushy stunt," says Duffus. Their outdoor tests of processing tomatoes, planted in soil infected with the virus, showed that among eight leading commercial varieties, Centurion and H-100 are much more resistant than strains such as UC-82 or P-95.

Now, in laboratory tests of those varieties, they're looking for a convenient marker or early sign of resistance. The discovery of a marker might speed selection of the most promising new tomato types.

"A fast indicator may be what's known as titer—the abundance of virus particles in tomato tissue," says Gerik. "You find the titer by checking sap a week after infecting plants with the virus."

Raising naturally resistant varieties will likely prove to be a more desirable option than costlier tactics such as fumigating soil with methyl bromide or covering vacant tomato beds with plastic sheets so the desert sun can superheat the ground and kill the microorganisms.

Another option—to abandon tomato production on infected soils and move to other sites in the valley—offers a stop-gap remedy but not a long-term solution.

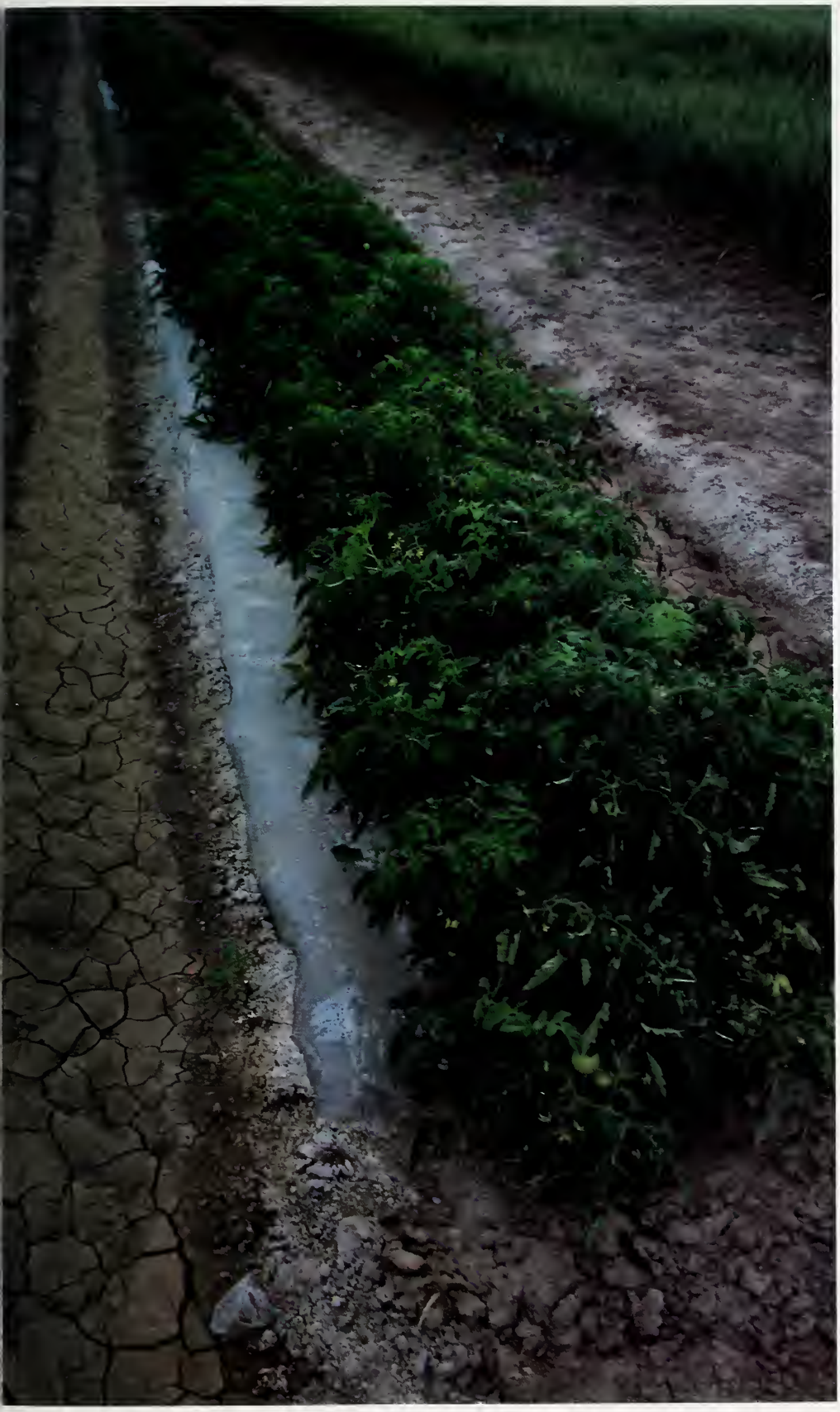
The virus got its name from the stunted, unnaturally bushy appearance of infected plants. A healthy tomato plant's low-growing vines sport lots of healthy green leaves that shelter fruit from the sun.

But plants stricken with the virus become malformed, spiky bushes. Their yellowed, unnaturally curled leaves expose the tomatoes to the sun. Sunburnt tomatoes look bad, taste funny, and aren't marketable. The virus can affect whole fields and reduce yields by as much as 80 percent.

A problem in the valley since 1977, the bushy stunt virus lives in the soil and flourishes in the cool

JAMES GERIK

**Tomato plants at left reflect damage from the soilborne tomato bushy stunt virus. Healthy plants at right are growing in soil that was covered with plastic.**



weather of late winter, when young tomato seedlings are struggling to get established. When temperatures climb in early spring, the virus all but disappears. By the time the virus begins to fade, however, it's too late for infected plants to recover.

At Donbee Farms, owner Donald Cox has lost about $400,000 worth of tomatoes in four different bouts with the virus. His was the first farm in the valley to be attacked by the troublesome disease. Symptoms appear only after the virus has already taken hold, he says. And fields "seem to go down overnight.

"There are always problems with tomatoes, because they're so delicate," Cox says. "But almost everything else that can happen to tomatoes is more manageable than bushy stunt—it's the worst deal ever."

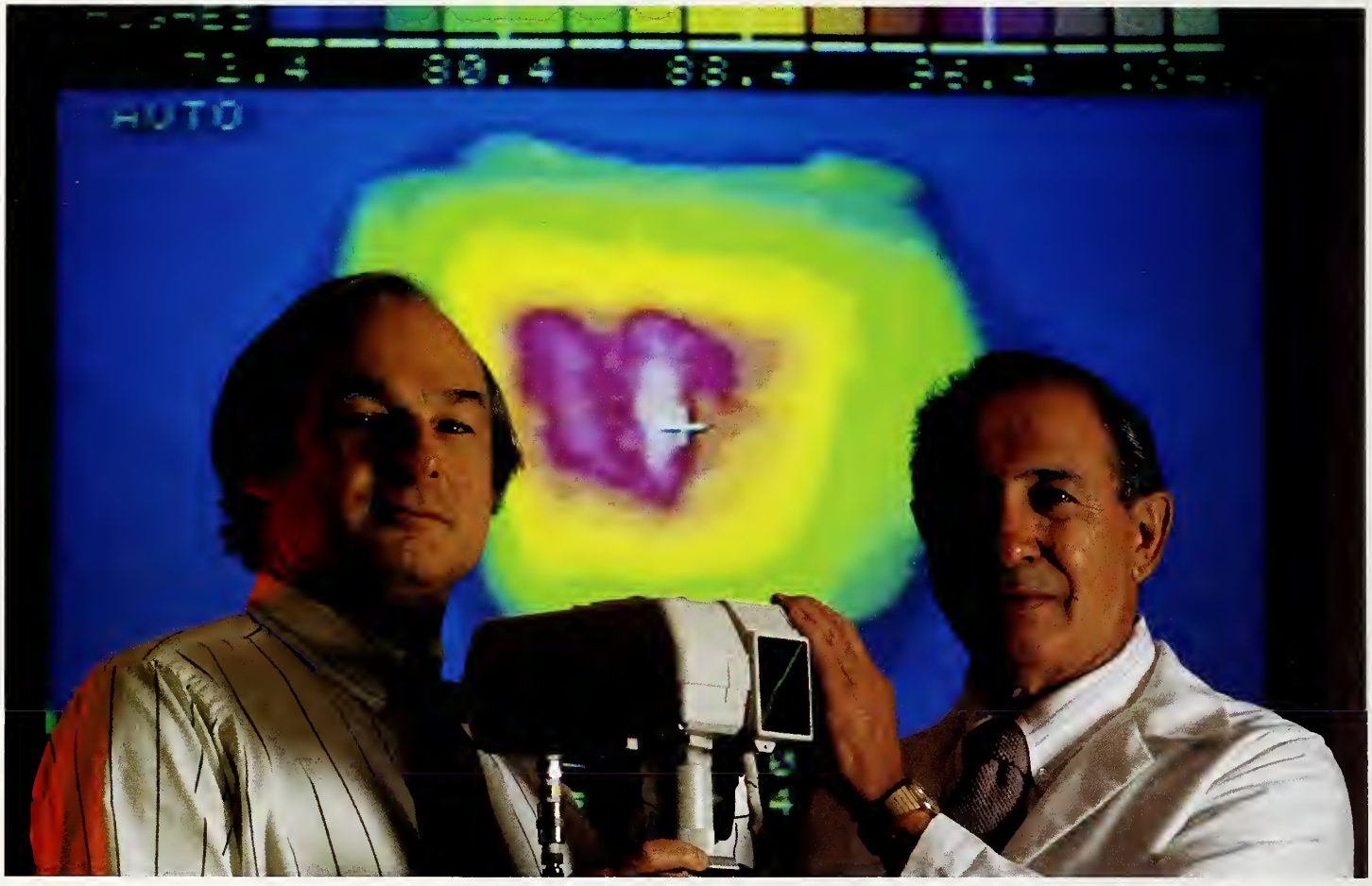
Even though the Imperial Valley's tomato production is dwarfed by that of the San Joaquin Valley to the north, Imperial offers something no other California region can, that is, the earliest possible start to the processing-tomato harvest.

Imperial-grown tomatoes are ready 4 weeks earlier than those in any other part of California, the nation's leading tomato-growing state. Early harvest offers canners a longer season, which in turn makes better use of their equipment.

The virus not only imperils profits of Imperial growers but also worries their counterparts to the north, even though the virus hasn't attacked tomatoes outside the desert. Duffus and Gerik hope to pinpoint the virus' source, and may at the same time allay the fears of tomato growers elsewhere in the United States.—By **Marcia Wood**, ARS.

*James E. Duffus and James S. Gerik are with the USDA-ARS U.S. Agricultural Experiment Station, 1636 East Alisal, Salinas, CA 93905 (408) 755-2825.* ◆

PERRY A. RECH




**To determine the surface temperature of a fabric sample placed in front of heat source, research chemists Tyrone Vigo (left) and Joseph Bruno utilize an infrared camera that displays heat intensity as various shades of color on a video monitor. (K-3835-15)**

# Thermal Fabric Attracts Commercial Interest

## Too warm or cold? Temperature-adaptable textiles may hit the market soon.

A new Iowa firm and one of Japan's largest companies have been licensed to develop products using a U.S. Department of Agriculture-patented process that makes fabrics respond to changes in temperature.

"NeutraTherm of Des Moines and Mitsui & Company of Tokyo have received exclusive licenses for the process called Polytherm," says M. Ann Whitehead. She coordinates the national patent program for USDA's Agricultural Research Service.

"Temperature-adaptable textiles with built-in thermostats warm you when you're cold and cool you when you're hot," says Tyrone L. Vigo, a chemist at the ARS Southern Regional Research Center in New Orleans. He and colleague Joseph S. Bruno invented the treatment in 1985. *[See* Agricultural Research, *March 1988 p. 16 and April 1987 pp. 14-15.]*

Vigo and Bruno treated fabrics with a class of chemicals called PEG's, short for polyethylene glycols. In laboratory tests, the fabric absorbed and stored heat when the temperature rose and released it when the temperature dropped.

Depending on the kind of material treated, the chemical applied, and the amount used, "a 50- to 100-percent increase in heat absorption or release is probably a realistic goal," Vigo says.

"NeutraTherm is developing the thermal technology for clothes worn next to the skin and for biomedical products such as surgical gowns and dressings for medical personnel and patients," says Steven Harlan, M.D., president of the Iowa-based company. Last fall, his company introduced a line of thermal inner/outer sportswear.

Members of the U.S. Olympic Ski Team tested treated T-shirts, and members of the Professional Ski Instructors of America tested stylized long underwear provided by the company, says Denny Watkins, director of operations.

A Mitsui subsidiary, Intertex Inc., is developing skiwear—jackets, pants, gloves, and shoe linings. According to president Hiroke Umazaki, the company is planning a March exhibit of their line of skiwear in Tokyo. They next plan to market underwear.

According to Whitehead, under terms of the licensing agreement, Intertex "cannot export any ski sportswear or biomedical products made using the ARS-patented technology. The products can be sold and used only in Japan. Also, the company will provide us with complete feedback on any research findings."

ARS research had shown that fabrics treated with PEG's had high water absorbency, excellent soil release, less pilling (lint balls), and improved durable-press wear and antistatic qualities.

NeutraTherm has been working with Vigo and Bruno for about 3 years perfecting their thermal technology. "We are finding that treated garments have several other qualities that are commercially attractive," says Watkins.

"Trials with NeutraTherm-treated socks worn for 3 consecutive days showed they did not pick up the characteristic foot odor from bacterial growth caused by heat and sweat, unlike their untreated counterpart," he says.

Further testing of the underwear confirmed that the PEG polymer treatment imparts antibacterial qualities to the garment.

Data from a questionnaire completed by the ski team and others who wore socks and T-shirts suggested that treated garments were wind-resistant.

Wickers International, Long Island, New York, will be introducing new high-tech products using the PEG polymer this spring. NeutraTherm is planning on introducing their own line of inner/outer wear and glove liners as well as hunting and sking socks early this year.

High-tech material using the NeutraTherm polymer will include microwavable gloves that retain heat to help prevent frostbite and to aid people suffering from Raynaud's disease, an arterial disorder of the fingers.

"In the near future, as NeutraTherm develops its own products, we plan to sublicense the technology for use in socks, facial masks, hats and gloves, and other ski clothing and sportswear, as well as biomedical products," Watkins says. "We have been talking with several large manufacturers of these items both here and abroad."—By **Hank Becker**, ARS.

*M. Ann Whitehead is at the USDA-ARS Beltsville Agricultural Research Center, Room 401, Bldg. 005, Beltsville, MD 20705 (301) 344-2786. Tyrone L. Vigo is at the USDA-ARS Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179 (504) 286-4487.* ◆

PERRY A. RECH

**A sample of fabric prepared for testing on a differential scanning calorimeter to determine the fabric's heating and cooling capacity. (K-3834-8)**

# Whitefly Causes Bleak Times for Growers

Producers face whole armies of tiny, disease-spreading marauders.

It attacks lettuce, tomatoes, cantaloupe, watermelon, cucumber, sugar beets, and squash. It also goes after cotton, beans, and soybeans and has a real penchant for ornamentals, especially poinsettias.

A truly diverse and voracious appetite distinguishes the sweetpotato whitefly *(Bemisia tabaci)*, which lives on the underside of leaves. It not only reduces yields by sucking life-giving nutrients from host plants, but it also spreads deadly plant viruses. Adding insult to injury, it leaves behind a sugary substance that makes an ideal growth medium for sooty mold on host plants.

ARS entomologist John W. Neal says when you walk through a greenhouse of plants that are badly infested, the disturbed insects look like a cloud of dandruff. Alone, a mature whitefly looks somewhat like a piece of ash from a burning log, while immature whiteflies are scale-like and semi-transparent.

Since 1986, this tiny pest has been causing serious economic problems for U.S. vegetable, cotton, and ornamental growers. First recorded on tobacco in Greece in 1889, the sweetpotato whitefly is found on crops throughout the world.

"No satisfactory chemical control exists for it on any crop," says Richard S. Soper, ARS program leader for biocontrol. "One of the most disturbing things is its ability to become resistant to almost any chemical used against it."

How significant are problems caused by the sweetpotato whitefly in the United States?

"Last season, it cost Florida tomato growers between $20 and $40 million, wiping out 25 percent of the crop," according to Wayne Hawkins. Hawkins, executive vice president of the Florida Tomato Exchange, says this estimate doesn't include handling or transportation costs.

RANDALL SMITH

**The underside of a squash leaf is dotted with eggs from these sweetpotato whiteflies. (K-3922-11)**

"The whitefly spells devastation for Florida tomato growers," Hawkins says. "It causes tomatoes to ripen unevenly, resulting in white longitudinal streaks on fruit and an increase in internal white tissue. Before ripening, however, there is no visible sign of whitefly damage on the tomato or the plant. Since we harvest and ship mature green tomatoes, the insect damage is not detectable until arrival at some distant market."

Tomatoes are not the only targets; the sweetpotato whitefly has homed in on squash with a new disorder, called squash silverleaf, which reduces fruit quality and yield.

"Although it's of unknown origin, every case of this disorder we studied was associated with the sweetpotato whitefly," says Raymond K. Yokomi. Yokomi is an ARS entomologist at the U.S. Horticultural Laboratory in Orlando, Florida.

Desmond R. Jimenez, an ARS chemist at the Orlando lab, is working with Yokomi to determine how the whitefly causes squash silverleaf and irregular ripening of tomatoes. "We're looking for a phytotoxic factor (poisonous to the plant) in the insect that could be responsible for these disorders," Jimenez says.

In California, the sweetpotato whitefly spreads the lettuce infectious yellows virus. *[See* Agricultural Research, *September 1988, pp.10-12.]*

Hawkins says a new whitefly-transmitted geminivirus outbreak last

RANDALL SMITH

**Entomologists Kim Hoelmer (left) and Desmond Jimenez examine an acrylamide gel containing proteins extracted from squash plants that were colonized with sweetpotato whiteflies. (K-3927-17)**

year caused inestimable damage to Florida tomatoes. This problem is readily apparent and the disease spreads rapidly through a field—plants are stunted and they turn from green to either a mottled yellow or purple. The geminivirus has definitely been linked to the sweetpotato whitefly. "The Florida tomato industry established a Sweetpotato Whitefly Task Force that went to Congress last year for funds to increase ARS research efforts to control the spread of this pest," Hawkins explains.

In addition to Hawkins' Florida Tomato Exchange, the Task Force includes the American Association of Nurserymen, Florida Fruit and Vegetable Association, National Cotton Council of America, Society of American Florists, United Fresh Fruit and Vegetable Association, and Western Growers Association.

### Not Just the Veggies Suffer

It's not only vegetable crops that appeal to the sweetpotato whitefly. Evidently, cotton is just as appetizing. "There seems to be something in the cotton plant that attracts the whitefly," ARS entomologist Hollis Flint says. "It walks around on the underside of plant leaves, finds a good spot to draw out the phloem sap, and becomes sedentary, sucking away." The insect has developed a digestive system that excretes the sugars it doesn't use from the sap, says Flint, who is located at the ARS Western Cotton Research Laboratory in Phoenix, Arizona.

"This sticky stuff then coats the cotton lint in open bolls," Flint says. In addition to serving as a growth medium for molds, this sugary substance creates a big problem when the cotton is picked and goes to gin. He says an even bigger problem occurs when the sticky cotton is processed for cloth. It clogs up the machinery.

John Neal and Jo-Ann Bentz, entomologists with the ARS Florist and Nursery Crops Laboratory in Beltsville, Maryland, are also working on possible controls for the pest.

"We now have a natural product that kills sweetpotato whitefly nymphs," Neal says. "Similar to Safer's soaps now used in greenhouses, this biosoap seems to dissolve the waxy cuticle of the pest. We've been testing it for 3 years in the laboratory."

Neal's biosoap is made of extracts from a species of greenhouse-grown *Nicotiana*, a relative of the tobacco plant. Having its own wetting agent, the extract can simply be mixed with water and sprayed on plants. Neal got his extracts from chemist George Buta of the ARS Plant Hormone Laboratory in Beltsville.

"We're evaluating 66 species of *Nicotiana* and so far have found 8 very effective ones," Neal says. He credits ARS retired agronomist George Pittarelli for originally noting resistance of *Nicotiana* species to whiteflies.

RANDALL SMITH

**The beetle *Delphastus pusillus Casey* is a promising predator for sweetpotato whitefly control in greenhouses. It is not considered a picky eater, though it prefers sweetpotato whitefly eggs to the fully developed adult. (K-3922-17)**

RANDALL SMITH

**Entomologist Raymond K. Yokomi collects sweetpotato whiteflies in a squash field for studies of squash silverleaf and tomato irregular ripening. (K-3926-5)**

Since the whitefly is a worldwide pest, ARS is studying natural enemies in other countries, hoping to import likely candidates for evaluation in the United States. The ARS European Parasite Laboratory, Behoust, France, will begin a project this spring to identify important natural enemies of the sweetpotato whitefly. Foreign exploration could include Pakistan, southern Europe, the Caribbean, Central and South America, the Near East, and North Africa.—By **Doris Stanley**, ARS.

*[If you are interested in contacting scientists mentioned in this article, write or telephone the Editor, Agricultural Research, Bldg. 005, Beltsville Agricultural Research Center-West, Beltsville, MD 20705 301-344-3280.]* ◆

MATHIAS SILBERNAGEL

# Better Beans From Tanzania

**U.S. and African scientists step carefully around terraced trial plots of bean plants.**

Beans—known as "maharagwe" in Swahili—are a daily staple for many East Africans. Served with corn or rice, they provide an important protein source for families who grow their own food.

Many traditional African bean varieties are very susceptible to diseases and often yield meager harvests. But a long-term collaboration between an ARS plant pathologist and Tanzanian scientists is helping to remedy the situation. Their job—to breed disease-resistant, high-yielding beans—also benefits scientists and growers in the United States.

For 10 years, Mathias J. Silbernagel has been the principal U.S. investigator for the Bean-Cowpea Collaborative Research Support Program (CRSP) in Tanzania. The program is one of seven projects funded by the U.S. Agency for International Development to help developing countries achieve self-sufficiency in producing food crops.

During his annual month-long sojourns to Africa, Silbernagel works directly with scientists at Sokoine University of Agriculture in Morogoro, Tanzania.

CRSP centers on the problems of small-scale farmers in traditional settings, taking into account agronomic, biological, and socio-economic factors.

"In our breeding work, disease-resistance and yield are primary, but we also consider other issues of

importance to Tanzanian women, who do most of the bean weeding, harvesting, storing, marketing, and cooking," says Silbernagel. Working with agricultural anthropologist Lorna Butler, of Washington State University, they have also gathered information about food preferences, bean cooking characteristics, and nutrition, which guides the development of improved beans.

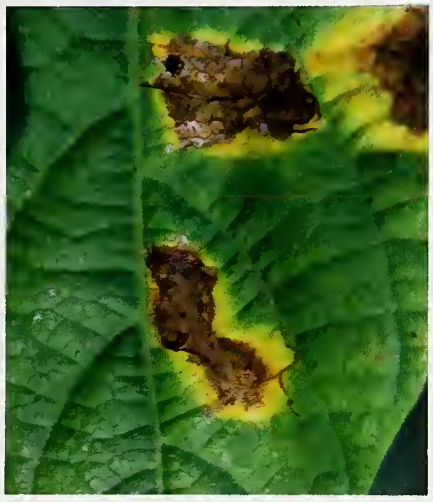
Some bean varieties, when cooked, tend to sour more quickly than others. That characteristic, explains Silbernagel, is important, because not all beans are eaten right after cooking, and refrigeration is uncommon.

"Women often hike miles each day to their family's shambas, or small gardens, to tend crops," says Silbernagel. "There, when you pack a lunch, you don't grab a baloney sandwich—you pack last night's meal in a tin."

The scientists are now completing the final testing of several promising new bean varieties in plots near Sokoine University. Before the varieties are released, they'll also be tested on small family farms on the Tanzanian savannah.

Another important outcrop of Silbernagel's collaboration was adapting a method to detect bean common mosaic virus that's faster and less expensive than previous techniques. The test assures farmers that they're planting seeds free of the disease, which can severely cut yields. Leaves patterned in a mosaic of puckered green areas and yellow-green patches are the earmarks of the disease.

MATHIAS SILBERNAGEL



**Symptoms of an unidentified virus on a bean leaf in Tanzania.**

After validating the test in Tanzania, where many isolates of the virus occur, researchers now use the antibody-based test on seeds for certification programs in the United States. Seedborne viruses may enter our country via international seed-trading companies that export beans from Africa.

"We can anticipate diseases that may end up here," explains Silbernagel, "because we've seen them already in Africa."

Says Gaylord Mink, a Washington State University virologist who worked with Silbernagel to create the screening test, "It's a classic example of how involvement in international programs can have widespread benefits."

Seven similar but distinct projects in other African and southern Central American countries make up the international Bean-Cowpea CRSP. Leading researchers in various disciplines are selected from around the United States and abroad to participate.

"We look for scientists like Matt who have a strong research program in the United States and who study problems here that are similar to those in developing countries," says Russel D. Freed, deputy director of the Bean-Cowpea CRSP Management Office, headquartered at Michigan State University.

Silbernagel stops in different countries en route to Africa to collect germplasm used to breed new improved bean varieties. He found bean plants in Colombia with stiff, upright stems that hold plants above the soil, instead of sprawled on the ground like typical U.S. varieties. Plants that don't touch the soil resist white mold infections; the Colombian bean plant also withstands troublesome root rot diseases.

"If we can breed these traits to pinto, navy, and other varieties, it could revolutionize our dry bean production," says Silbernagel.— By **Julie Corliss**, ARS.

*Mathias J. Silbernagel is in USDA-ARS Vegetable and Forage Crop Production Research, Rte. 2 Box 2953A, Prosser, WA 99350 (509) 786-3454.* ◆

MATHIAS SILBERNAGEL

**Common bacterial blight on Tanzanian bean leaf.**

## Is There A Good Chance of Rain?

If it is going to rain tomorrow, you really don't need to irrigate today. And if the ground is already wet and it is going to rain tomorrow, you may need to drain your fields today.

Obvious enough—but how do you figure your odds of the weather forecast being right in advance of tomorrow's rain against a crop's need for just the right amount of water?

Integrating all the data and coming up with a "drain, irrigate, or hold everything" decision is the job the RPI computer model was designed for by agricultural engineer James L. Fouss.

RPI, which stands for Rainfall Probability Index, works from a statistical average of daily rainfall predictions for the forthcoming 36 hours—predictions for that day, that night, and the next day.

It is designed to provide an alternative to managing water tables in the soil based solely on the current depth of the water. Decisions that are based on water table depth alone could lead to draining water that would be needed the next day or irrigating when water will be surplus the next day, according to Fouss.

"The purpose of RPI is twofold: to maximize water storage in the soil by not draining unnecessarily and minimize the time there is too much water or too little water in the root zone," says Fouss.

"If a farmer drains a field today and it doesn't rain, or if a farmer doesn't drain and it does rain and this happens just a few times during the growing season, it can significantly cut crop yields," he adds.

In the future, the RPI concept might have an even more important role. It may help a farmer decide when to apply pesticides and fertilizers in order to maximize their effectiveness and minimize their losses in runoff or through leaching.

Fouss and his colleagues are currently working on an integrated model system with companion field experiments for controlling water tables and applying pesticides and fertilizer.

RPI needs to be run by agencies such as the National Weather Service Regional Centers.

"Individual farmers usually don't have the type of computer or the necessary data to use the model at home," says Fouss. "But it would be fairly easy for an organization like the National Weather Service to add the RPI figure to the regional agricultural weather forecasts."

An RPI of 80 percent or above should trigger draining. An RPI of 50 to 80 percent means delay irrigation, and an RPI of less than 40 percent means irrigation would be worthwhile to increase moisture in the field.

He has discussed the possibility of the Weather Service trying out RPI; they would like to see more field testing first.

Fouss will be using the RPI to guide irrigation and drainage decisions on the fields managed by the ARS Soil and Water Research unit in Baton Rouge, Louisiana, where he is located.

The data will come from the Southern Regional Climate Center of the National Weather Service, so they will be able to see how RPI could fit in with their regional forecasts.

In order to be accurate enough, RPI has to have separate regional versions to take into account rainfall patterns and soil types. Fouss has already formulated RPI models for southern Louisiana, North Carolina, central Ohio, and northern Ohio.

About the southern Louisiana model, Fouss says, "In 3 years out of 6 that we looked at, letting the RPI guide irrigation and drainage would have increased the yield of corn."

The yield increases predicted by the model would have been 14, 82, and 25 percent in 1980, 1982, and 1984, respectively. Possibly even more important, the irrigation water required would have been reduced by 6, 32, 24, and 27 percent in 1981, 1982, 1984, and 1985.

The RPI would be particularly convenient for farmers who use a computer to control their drainage/irrigation systems. It can be integrated with their programs so that the computer automatically overrides responses to the water table depth if RPI has given a counter-indication.—by **J. Kim Kaplan**, ARS.

*James Fouss is in USDA-ARS Soil and Water Research, P.O. Box 25071, Baton Rouge, LA 70894 (504) 388-6010.* ◆

**Sugarcane**

## Higher Yields, More Years for Sugarcane

Not only can installing subsurface drain pipes in sugarcane fields increase yields, it can also help a grower get more years from each planting.

Traditionally, a grower gets 3 years of harvest from a cane planting before yields drop to the point where it is more profitable to plant again.

"But by controlling the water table completely with subsurface drainage, a grower can get 5 years of harvest before yields drop off to the replanting level," says ARS agricultural engineer Cade E. Carter of the Soil and Water Research Laboratory in Baton Rouge, Louisiana.

Being able to lower the water table through the drain pipes keeps the soil in better condition for growing sugarcane.

The cost of installing the subsurface drain lines comes to about $325 per acre, according to Carter, if they are placed 2-1/2 feet below the roots.

"Deeper would be better but more expensive. Two and a half feet is really the breakeven point," he says.

With high yields and 2 extra years of harvest, growers could make back

their installation costs in the first planting, at the current price of sugar, Carter points out.

In 11 years of tests on plots with and without subsurface drain lines, Carter has had yields an average of 500 pounds of sugar per acre higher in the drained fields.

"In the best year, the increase in yield was about 1,500 pounds of sugar per acre, which comes to $664 per acre income compared to the $485 per acre that undrained fields produced that year," Carter says.—By **J. Kim Kaplan**, ARS.

*Cade E. Carter is at the Soil and Water Research Laboratory, Box 25071, Baton Rouge, LA 70894 (504) 343-3367.* ◆

## Food Fat Lingers in Older Folks' Blood

It seems that everything slows down as we get older, and new findings on how we handle dietary fat bear this out.

Three years ago, a study at ARS' Human Nutrition Research Center on Aging at Tufts showed that older people have significantly more fat circulating in their blood after a fat-rich meal than younger people do. Since elevated triglycerides—as fats are called—contribute to the risk of heart disease, the finding has important implications.

While it could mean that older people absorb more fat than younger people, Ernst J. Schaefer and Jeffrey S. Cohn, who are with the center's Lipid Metabolism Laboratory, think it more likely that older people are simply slower at moving fat out of circulation.

To find out, they joined with Stephen A. Krasinski and Robert M. Russell, also at the center, who had found that older people also have higher blood levels of vitamin A than their younger counterparts. Since the vitamin is fat-soluble, it gets packaged together with triglycerides in intestinal cells before entering the blood and stays with the fat-rich particles in circulation. So they reasoned they could use vitamin A as a marker to gauge how fast the body cleared dietary fats from the blood by measuring the vitamin's clearance rate.

Eighteen men and women—half of them under 30 years old and the other half over 60—participated in this study. After an overnight fast, they ate a meal of soybean oil containing a large dose of retinyl ester—a form of vitamin A—as the marker. Then each donated about a pint of plasma, which was reinjected 2 days later after another overnight fast. By withdrawing blood samples before and at regular intervals after the plasma infusion, the researchers tracked the disappearance of infused vitamin A and related that to triglyceride levels throughout the same period.

"Vitamin A remained in the blood of the over-60 group almost twice as long as it did in that of the under-30 group," says Schaefer, a medical doctor who oversees lipid metabolism research at the center. "Mean residence time of the vitamin was 57 minutes in the older group and 31 minutes in the younger. We think the difference is due to less active liver receptors," he says, referring to the proteins on the surface of liver cells that usher these fat-rich particles inside.

Schaefer says,"This is another good reason for older people to restrict their fat intake to some extent—these particles potentially lead to plaque buildup."—By **Judy McBride,** ARS.

*Ernst J. Schaefer is at the USDA-ARS Human Nutrition Research Center on Aging at Tufts, 711 Washington St., Boston, MA 02111 (617) 556-3100.* ◆

## It's Iturin

A bacterial byproduct could become a replacement for chemical fungicides used to control field and storage molds, including the aflatoxin producer *Aspergillus flavus.*

The substance, called iturin, is actually a mixture of about eight similar compounds produced by a number of *Bacillus* bacterial species.

"The compound is a good fungicide. But the trick is to find or create a *Bacillus* strain that will produce iturin in large enough quantities to make it commercially feasible," says ARS plant physiologist Alan R. Lax, who is studying iturin's potential along with chemist John M. Bland and microbiologist Maren A. Klich at the Southern Regional Research Center in New Orleans.

The three looked at dozens of bacterial products before settling on iturin to develop as a fungicide.

"We were looking for one that would target harmful fungi, cause no environmental damage, and be producible on the same economic scale as the old chemical choices," Bland says.

A biological fungicide has to be hot, fast, and cheap," Lax adds, "if it's ever going to be a commercial product."

In laboratory experiments, very low concentrations of iturin have proven effective against a broad spectrum of fungi that includes *Penicillium italicum,* a pathogen of stored citrus; *P. expansum,* which causes storage rot in apples; aflatoxin-producer *Aspergillus flavus;* and *Fusarium moniliforme,* a grain-attacking mold that is toxic to chickens and horses.

The team is basically looking at iturin for use as a fungicidal seed coating. Losses in the seed industry due to soilborne fungal pathogens may amount to $4 billion each year.

They are also investigating its potential to prevent decline of feed quality caused by contamination with mycotic fungi.

Currently, the team is trying to optimize the growing conditions for producing iturin and selecting the best potential producer.

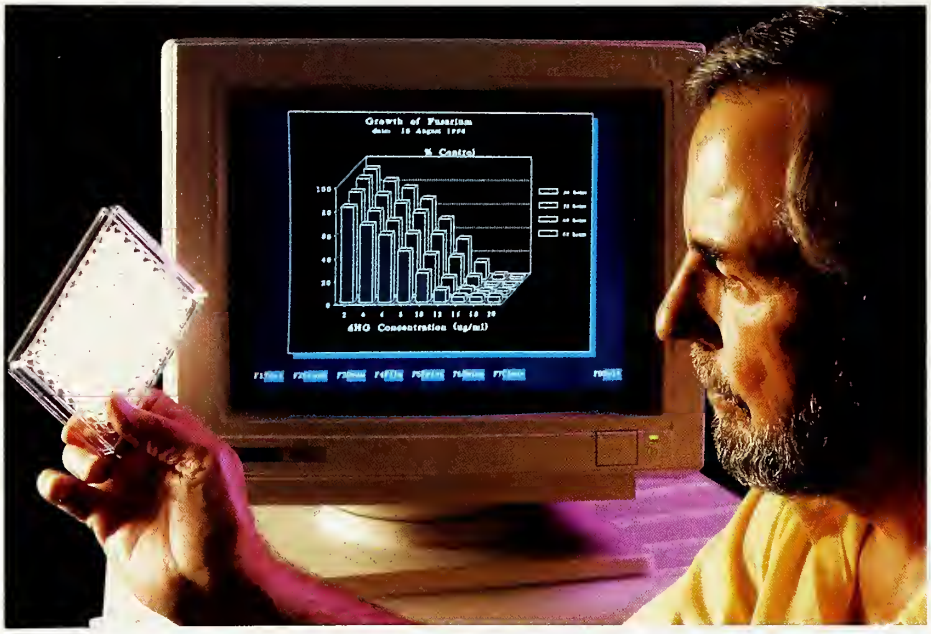
"Iturin producers don't tend to be fussy organisms, but growing conditions do affect the yield," says Klich.

The team doesn't really expect to find a bacterial strain immediately that will produce commercial levels. Once they settle on one source as the starting point, they will begin experiments to breed a better strain either by natural selection or artificial treatments.

Eventually, the scientists expect to enter into a research and development agreement with a company that would market the biological fungicide.—By **J. Kim Kaplan,** ARS.

*Alan Lax, John M. Bland, and Maren A. Klich are at the USDA-ARS Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179 (504) 286-4200.* ◆

PERRY A. RECH




**Plant pathologist Marshall Mace checks for *Verticillium* and *Fusarium* growth in the presence of a natural antibiotic produced by cotton plants. (K-3816-1)**

## Why Scientists Cotton to Egyptian Cotton

A trio of U.S. Department of Agriculture scientists has solved a natural mystery from the land of the pharaohs: What makes Egyptian cotton so tough?

Egyptian cotton, *Gossypium barbadense*, boasts a resistance to Verticillium wilt disease that U.S. cotton growers would love to transplant into their favorite cotton, *Gossypium hirsutum*. Verticillium wilt is caused by the fungal pathogen *Verticillium dahliae*.

The secret of resistance, says plant pathologist Marshall E. Mace, is the speed with which *G. barbadense* can plug its own vessels and immobilize the pathogen before it spreads throughout the plant. Mace, chemist Robert D. Stipanovic, and plant pathologist Alois A. Bell have been studying the cotton disease puzzle at ARS' Southern Crops Research Laboratory at College Station, Texas.

Mace says the crucial plugging inside the plant occurs when cells next to the infected vessel wall swell, restricting the passageway where the pathogen lurks.

After the cells trap the pathogen, a natural antibiotic called desoxyhemigossypol, or dHG, goes into action, eventually killing the invader.

Although the cotton plant actually produces four antibiotics in its own defense, dHG is the most important because it is water soluble and can move in the plant to reach the pathogen.

The same vessel-plugging response to invasion is seen in *G. hirsutum*, but much slower—so slow, in fact, that by the time dHG arrives on the scene, the pathogen has already spread throughout the plant.

"Very large amounts of dHG will actually accumulate in *G. hirsutum*," says Mace. "But if the spread of the pathogen isn't restricted rapidly, it's irrelevant."

American farmers aren't interested in switching to *G. barbadense* to thwart the pathogen because *G. hirsutum* yields are higher and the plants are adapted to wider geographic areas of growth.

Attempts to breed the quick response of the Egyptian cotton into *G. hirsutum* have fallen flat: "The first-generation hybrid looks pretty good, but you lose the resistance in later generations," Mace notes.

Still, the ARS scientists have had significant successes on the rocky road to resistance. It was Bell and Stipanovic who discovered and identified the four antibiotics, and Mace was the first to demonstrate the differences in the plugging response in *G. barbadense* and *G. hirsutum*. Mace later demonstrated the toxicity of dHG, the importance of its water solubility, and its actual contact with the pathogen.

Next, the scientists will study the Acala lines of *G. hirsutum* that have tolerance to *Verticillium dahliae*.

"If they're resistant through the same mechanism as *barbadense*, plant breeders might try to transfer this into other *hirsutum* cottons," Mace says.—By **Sandy Miller Hays**, ARS.

*Marshall E. Mace, Robert D. Stipanovic, and Alois A. Bell are in USDA-ARS Cotton Pathology Research, Southern Crops Research Laboratory, F&B Road, College Station, TX 77841 (409) 260-9233.* ◆

## Apple Tree Disease Blamed on MLO

A mysterious disease began spreading through apple orchards in Washington State about 8 years ago. Leaves on infected trees curled inward, and branches stopped growing. Within a year or two, the trees started to die.

But to plant pathologist C. Lee Parish, of the ARS Tree Fruit Research Laboratory in Wenatchee, Washington, the syndrome seemed familiar. He'd seen similar symptoms in apricot trees in France. Parish learned from a European colleague that the disease, called apricot leaf roll, was probably due to a mycoplasmalike organism, or MLO. (Mycoplasmas are minute organisms without cell walls that can cause diseases just as bacteria and viruses do.)

Using a technique developed in Germany, Parish tested the ailing apple trees near Wenatchee, and sure enough, they too were positive for an MLO. Roots of infected trees can't deliver nutrients to the tree, which is why it withers and dies. Thousands of

trees in the Pacific Northwest show signs of infection—mainly Red and Golden Delicious varieties.

Although the disease can be effectively treated with tetracycline (administered with a drill, a syringe, and about 220 pounds of pressure), prevention would obviously be preferable.

The problem is, nobody knows how the disease is transmitted, although when it strikes a tree in an orchard, the malady seems to spread to nearby trees in all directions, "like a ripple in a pond," says Parish.

Such a pattern suggests that a soil-borne vector or a nonwinged insect may be involved. A vector is an organism that transmits a pathogen (in this case, the MLO). A random, scattered disease pattern within an orchard, in contrast, suggests the work of a winged insect.

To check that hypothesis, Parish and his colleagues are working on a test that uses a piece of the MLO's genetic material to see if other orchard-dwelling insects or plants harbor the MLO. The technique will take at least 2 years to perfect, says Parish.

Once they find the cause, they'll push ahead to prevention, which could involve eliminating the insect vectors, or any plants that serve as alternate hosts for the pathogen. Preventing the disease could save apple growers hundreds of thousands of dollars.—By **Julie Corliss**, ARS.

*C. Lee Parish is at the USDA-ARS Production, Harvesting, and Handling of Tree Fruits Research Unit, Wenatchee, WA (509) 664-2280.* ◆

## Eat Right and Build Immunity

What you eat affects your immune system—your body's natural defense against viruses, bacteria, and other nasty organisms. But the relation between food and immunity is a puzzle nutrition researchers have yet to solve.

In probing the link between fats and immunity, ARS chemist Darshan S. Kelley has seen immune responses boosted in volunteers on a nutritionally balanced, low-fat regimen.

In studies with rats and mice, however, other scientists have found that polyunsaturated fats high in omega-6 fatty acids—the kind in vegetable oils such as corn or safflower—suppress animals' immune systems. "That," says Kelley, "led to a concern. Would the immune system slow down in people who replace saturated fats with polyunsaturates to lower their blood pressure or cholesterol?"

To find out, Kelley put eight healthy young men, volunteers at the Western Human Nutrition Research Center, on an 80-day, low-fat regimen that had either a low or moderately high level of polyunsaturates.

Fat intake in everyone's meals added up to 25 percent of the day's total calories. That's 15 percent less fat than Americans typically eat.

Immune systems of all volunteers improved, whether they ate polyunsaturates in low amounts (3.5 percent of the day's total calories) or moderately high levels (13 percent of their total calories). An example: T and B lymphocytes—white blood cells that protect against invading organisms—proliferated at a higher rate in laboratory tests.

These results, Kelley says, are "a promising preliminary indication that you can favor heart-healthy polyunsaturates—in moderation—without suppressing your immune system."—By **Marcia Wood,** ARS.

*Darshan S. Kelley is with the USDA-ARS Western Human Nutrition Research Center, P.O. Box 29997, Presidio of San Francisco, CA 94129 (415) 556-4381.* ◆

## Letters

## On Sugar Consumption

We are writing regarding the article on "Preventing Diabetes With Chromium" in the October 1990 issue of Agricultural Research...to put the record straight on the use of table sugar.

Although we do not have figures on refined or table sugar consumption (sucrose) 100 years ago, we question whether it was as low as 4 pounds a year.

The first disappearance estimates of which we are aware were calculated from USDA data by Dr. Fred Gray and indicate in 1900 that sucrose [consumption] at that time was 65 pounds, and total sweetener disappearance was 77 pounds.

As a matter of fact, we know of no accurate source for consumption figures even today. What is available is USDA data on availability or disappearance of caloric sweeteners, including corn sweeteners, honey, dextrose, and edible syrups. Most recent figures show table sugar disappearance remaining stable at approximately 60 pounds per capita in 1989, after a rather steady decline from more than 100 pounds per person in 1969.

We know of no source for the statement that the use of table sugar has increased to about 115 pounds per year. This figure is closer to the total disappearance figure for all caloric sweeteners as estimated by the Food and Drug Administration task force evaluating sugars consumption and disappearance data in 1986 and confirmed by current USDA data.

As USDA's Economic Research Staff knows, arriving at accurate figures on sweetener consumption is not an easy task. The figures are often oversimplified in the popular press, but we were surprised to note that the Agricultural Research Service used imprecise information as well.

Sylvia Rowe
The Sugar Association, Inc.

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